Radiologic Quality and Safety: Mapping Value Into Radiology

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The authors have created a radiology quality map to help understand the opportunities for improvement in the radiologic safety, reliability, quality, and appropriateness of examinations and interventions. It entails 9 steps with dozens of specific opportunities for improving care to patients. The radiology profession has an obligation to robustly document and improve quality and safety in its practice.

Key Words: Best practice, outcomes assessment, radiology

J Am Coll Radiol 2005;2:992–1000. Copyright © 2005 American College of Radiology

INTRODUCTION

In 1900, the 13th International Medical Conference was held in Paris, France. Among those attending were Ernest Amory Codman, MD, the renowned orthopedic surgeon and skiagrapher (as radiologists were once called), of Massachusetts General Hospital; Albert J. Ochsner, MD; and William J. Mayo, MD, of the Mayo Clinic. They left the session, however, because they were weary of the endless papers, and the 3 of them discussed forming a new society that would meet and provide members the opportunity to watch surgical procedures in large amphitheaters at various institutions. Through this format, best practices would be adopted and new ideas shared. This group evolved into the present-day American Society of Clinical Surgery. Drs Codman, Ochsner, and Mayo, along with Harvey Cushing, MD, and others, were founding members.

Dr Codman was a champion of the "end result" idea that he first described in 1905: doctors should follow up with their patients to assess the results of their treatment. He proposed that the outcomes of hospitalization be recorded and made public for patients to consider in making their choices. This was considered heretical at the time, but in retrospect, Codman and others were pioneers.

In 1912, leaders of the American Society of Clinical Surgery created the Standardization of Hospitals Committee. Dr Codman chaired it, and Dr Mayo served as a member. Their recommendations included the following: "the essential factor which will most contribute to raising the standard of American hospitals is the establishment in each hospital of a follow-up system of tracing the outcome of treatment given to each individual patient" [1, p58]. Thus, a group of physician leaders in the early 1900s asked for the public review of outcomes, which is heard today from the Leapfrog Group, the Institute of Medicine, and other health care quality improvement organizations in the United States.

Dr Codman was an outspoken advocate of the end-result idea. At the Boston Medical Library on January 6, 1915, he proposed this idea to the Boston medical elite at their medical society meeting. His advocacy for standardization and for the measurement and publication of outcomes ended with his dismissal from Massachusetts General Hospital and his resignation from the standardization committee. The Mayo brothers (William and Charles H.) supported Codman and sent him letters expressing their regrets about these events. Here is what Dr Mayo wrote:

> Dear Dr. Codman, . . . No man can bring out a new and important idea without opposition. . . . Personally, I can only realize that I am making progress when I am stepped on because it means that there is movement that the conservatives want to check before it disturbs their positions. Cultivate a smile, don't take it too seriously, and keep at it, because you are right. Sincerely, W. J. Mayo.

Fundamental to the quality movement and US medicine in the 21st century are the same basic principles that Drs Codman, Mayo, Cushing, and Ochsner articulated in the formative days of organized medicine. Today physicians still struggle with standardization, best practices, process improvement, peer review, and outcome identification. Publishing results for public scrutiny remains a controversial topic.

The Institute of Medicine [2] has identified the chasm that exists in the quality of health care delivery. In an effort to awaken the medical community and prevent the loss of 48,000 to 100,000 lives each year to medical

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0091-2182/05/$30.00 • DOI 10.1016/j.jacr.2005.08.003

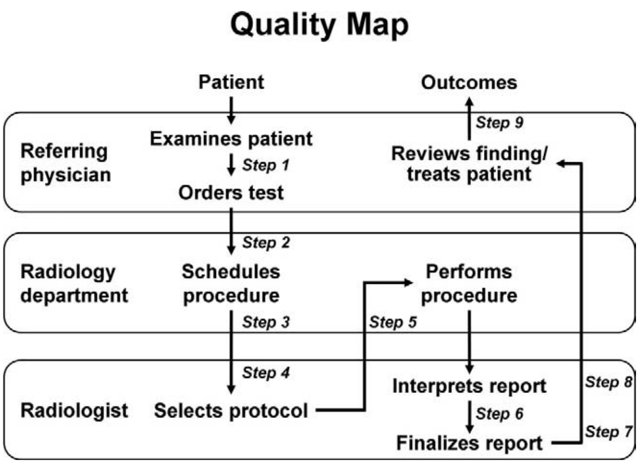

Fig. 1. Radiology quality map.

errors, 6 quality arms have been established: safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity. Radiologists have an opportunity and an obligation to respond to the Institute of Medicine's call to quality. Critical self-inspection, honesty, and perseverance are required if they are to make substantial gains in quality. They must also transition from being members of autonomous work units to being members of a core team who work within a system of care. Only by addressing the systemic need for improvement will sustainable change occur. This attitudinal shift does not negate individual responsibility but rather provides a broader view of the care processes and integrated value inherent in each step.

The American aviation industry became safer after World War II because accidents were no longer viewed primarily as individually caused, and safety no longer meant motivating people to try harder to be safe. Safety systems were embedded into the aviation industry at all levels, from pilots and companies to regulators and equipment manufacturers. The risk for dying in an aviation accident in the 1960s and 1970s was 1 in 2 million. After safety systems and standardization were put into place, the risk for dying decreased to 1 in 8 million in the 1990s. By comparison, adverse events in American hospitals occur at a frequency of 3% to 4% [3,4]. Radiologists need to adopt a similar systems or process approach to care based on standardized protocols.

RADIOLOGY QUALITY MAP

The radiology quality map, which shows the path of a patient through the diagnostic imaging and image-guided interventional activities within radiology departments, outlines steps when there are opportunities for process and outcome improvement in the radiology profession (Figure 1). The quality map is a framework on which one can build a total quality management program for the radiology profession and radiology departments.

Step 1: Physician Orders Examination

The first step in the radiology quality map is when a physician refers a patient to a radiology department for a diagnostic or interventional procedure (Table 1). The examination order presents the first opportunity for failure: was the correct examination ordered? Was it based on evidence in literature or Appropriateness Criteria™? Was there a misinterpretation by the scheduler because of impaired communication or a human error? Was contrast material ordered by the referring physician when it was not indicated or could be dangerous?

Appropriateness Criteria™. The ACR [5] has developed Appropriateness Criteria™ for imaging and treatment decisions. This exemplifies the leadership needed to make further progress in radiology quality and safety. It would be worthwhile to expand, update, and automate the Appropriateness Criteria™. Automation will promote the rapid dissemination of the criteria, and it will allow linkage to electronic medical records and computerized examination-ordering tools as well as to radiology scheduling functions. If updated Appropriateness Criteria™ are available at the sites of care, ordering, and scheduling, the likelihood will increase that the most appropriate examination will be performed. The use of Appropriateness Criteria™ should be encouraged and, in selected situations, monitored for quality and safety purposes.

The Appropriateness Criteria™ have shortcomings. Ideally, all the criteria would deal with issues of the severity and acuity of illness. Many complex unique situations warrant customized care. However, the basic principle of identifying a best practice and then standardizing it should stand as an overarching goal. As variation, waste, and defects are driven out, the quality and reliability of care should improve.

Another issue that some might have with the criteria is that they are developed for the most part by radiologists, who could be viewed as having either an incomplete understanding or a biased view of the rationale or indications for outcomes and appropriateness.

Finally, no matter how objective and evidence based the criteria might be, there will always be situations in which patients or ordering physicians will want examinations or procedures that have limited value. Is an examination with a 1:10,000 yield indicated? What about 1:1,000,000? Is the cutoff at a certain economic level? For how many examinations is this information available?

Evidence-Based Radiology. Much of what radiologists do is not evidence based. There are no sound

Table 1. Radiology quality map events and metrics

Step	Event	Metric
1	Referring physician orders examination	ACR Appropriateness Criteria™
		Intended examination (ordering error)
2	Appointment scheduled	Access times
3	Initial radiology encounter	Patient wait time
		Patient education: preparation, expectations, NPO status, diabetes
		Triage patient health needs
4	Protocol selection	Standardized protocol: best practice
		IV contrast media (yes/no)
		IV oral contrast media protocol
5	Patient examination	Environment of care
		Safety, comfort
		Procedural complications
		RN or RT credentialed
		Falls, infections, hand disinfectant
		Process effectiveness and efficiency
6	Interpretation	Peer-reviewed credentials
		Correct subspecialty interpretation
		Accuracy
		Structured report
		Report answers clinical question
7	Finalization	Errors
		Timelines
		Succinctness
8	Communication	Emergent/important
		Referring physician satisfaction
		Query answered/addressed
9	Outcomes	Health improved?
		Mortality/morbidity/QOL
		Patient satisfaction

Note: IV = intravenous; NPO = nothing by mouth; QOL = quality of life; RN = registered nurse; RT = radiologic technologist.

scientific data to support or refute the performance of specific examinations. In some situations, a plethora of evidence is ignored. For instance, there is some evidence that magnetic resonance imaging (MRI) for low back pain may not be the most appropriate first-line examination. Jarvik et al [6] found that in a randomized trial of radiography vs rapid MRI, patients examined with MRI had more expenses and 2.5 times more surgical procedures. No difference was found in clinical outcomes related to disability, pain, or general health status.

Chest radiographic screening for lung cancer is apparently quite common for high-risk individuals throughout the United States; many undergo chest computed tomographic (CT) screening. No medical society recommends screening for lung cancer, however, and there is no evidence that either CT or chest radiographic screening yields a disease-specific mortality benefit. In fact, the false-positive results and overdiagnosis inherent in lung cancer screening may result in more harm than good. Ensuring that the correct examination is ordered to answer the clinical question is the first step in radiologic quality improvement.

Overutilization. Much evidence suggests that there is substantial overutilization of imaging procedures in the United States, where 13% of the gross domestic product is spent on health care (7.3% in the United Kingdom). The United States has 8.1 MRI scanners and 13.6 CT scanners per million people (the United Kingdom has 3.9 MRI scanners and 6.5 CT scanners per million people) [7]. Although there are shorter lines and delays for access to scanners in the United States than in the United Kingdom, better outcomes of health care have not been demonstrated in the United States.

Some data suggest that approximately 30% of imaging procedures would not be performed if they were subjected to the Appropriateness Criteria™. Estimates of overutilization range from 20% to 40% [8,9]. National

Imaging Associates, which manages radiology benefits for 12 million people, stated that it can save its insurance clients 20% to 30% in the first year for high-technology imaging by instituting certain processes, including prior approval systems. A well-developed decision support system program could provide point-of-care knowledge for delivery of the most appropriate radiologic examinations and interventions. The decision support system could be developed and designed to decrease overuse of imaging tests by making ordering criteria widely available. The United Health Group stated that 30% to 40% of all imaging procedures are ordered appropriately [9,10].

Step 2: Appointment Is Scheduled: Timely Access

After the test is ordered, the next step in the quality map is determining how soon the test can be performed. Timeliness is one of the Institute of Medicine's 6 aims, and it has at least 3 gradations: emergent, urgent, and routine. Access times can be measured and have clear ramifications for outcomes in patient health care.

Step 3: Initial Radiology Encounter

Waiting Times. The patient arrives for the examination and then waits until it is performed. Although the duration of the patient's wait is not a safety measure, it is a quality measure and a determinant of patient satisfaction.

The Trade-Off Between Quality and Access. Screening for breast cancer with mammography is evidence based (although not without controversy). It has been shown to lower disease-specific mortality for breast cancer, but there is considerable variation in accuracy and recommendations throughout the country in accredited programs. To increase the median accuracy from 66% to 71%, approximately 6,000 practicing US radiologists (ie, the 30% who provide the least accurate interpretations) would have to be prohibited from interpreting mammograms. This would in turn reduce volume capacity for interpretation by approximately 25% [11].

Step 4: Protocol Selection: Standardized Best Practices

After the examination or procedure is scheduled but before it is performed, a protocol or process is selected. Even if there is no formal protocol, the radiologist determines how the examination is carried out. This step provides an important opportunity for departments and radiologists to identify a best practice. Ideally, the best practice would be evidence based. Regardless, it makes sense to identify a best practice, standardize it, and then use that experience to innovate better ways to care for patients. Innovations can best be tested against standards so that one can clearly understand whether an incremental change makes a difference. There are sound arguments for standardized protocols [12]. For instance, the size of a liver mass can be compared best if the comparison MRI scans are performed with precisely the same imaging protocol of enhancement, field of view, pulse sequence, and so on.

Table 2. Examples of factors that compromise quality or safety during the examination or procedure
Patient fall
Skin impairment
Nosocomial infection
Mislabeled examination
Improper radiation dose
Contrast-induced nephropathy
Wrong site for procedure
Wrong procedure
Wrong side for procedure
Wrong patient

Step 5: Patient Examination: Patient Safety

Patient safety is at greatest risk during the examination. Many safety metrics can be monitored at this time (Table 2).

Step 6: Interpretation

After an examination is performed, an interpretation is rendered. The accuracy of that interpretation is a critical determinant of outcomes and is directly related to overall quality. Accuracy less than 100% may be related to a detection interpretation or a communication error. Errors are common and human error results from interobserver and intraobserver variability [13]. Published evidence shows the value of double interpretations and computer-aided detection in raising accuracy rates. With the current reimbursement environment and salary expectations, there are economic impediments to optimizing sensitivity.

Accreditation Programs. Accreditation programs in mammography have made a difference in overall quality, but they do not completely address issues. Beam et al [14] studied 108 radiologists in 50 ACR-accredited centers involving the blind interpretation of 79 screened mammograms and found a range of 40% in screening sensitivity, a range of 45% in recommendations for biopsy, and a range of 11% in the detection of cancers. Compliance with technical standards for the performance of radiologic examinations is not enough to ensure an accurate, high-quality examination. Professional skill and clinical outcomes must also be measured.

Peer Review and Conflict of Interest. The expertise and ability of the performing and interpreting radiologists can be measured with peer review and other tools. Departmental peer review is a requirement of the Joint Commission on Accreditation of Healthcare Organizations [13], and the peer review of radiologists is a critical part of quality assessment and control. Most issues deal with interpretive and observational skills as well as adherence to best practices and conformance with protocol, but other factors, including certain biases, may be introduced by financial conflicts of interest, which must be identified and managed appropriately. These conflicts affect patient care with self-referral and may affect the interpretation of examinations. Examples include self-referral through advertising for freestanding imaging centers or radiology practices and relationships with attorneys for legal cases and expert testimony. In a recent study of "B" readers in asbestos-related litigation, Gitlin et al [15] found that the interpretations by radiologists who were retained by a plaintiff's attorney were substantially different from those of control "B" readers: radiologists retained by a plaintiff's attorney interpreted 96% of chest radiographs as "abnormal" (control "B" readers interpreted only 4.5% of chest radiographs as abnormal) and were 5.53 times more likely than the control group to rate an examination as good quality. One could argue that the radiologists retained by a plaintiff's attorney were biased by a financial conflict of interest.

Radiologic Errors. Errors in radiology have been studied extensively. Research has shown that errors can be reduced by improvements both in knowledge and in systems. Improvement in skills and knowledge may include comparison with previous studies, awareness of clinical history and presentation, routine systematic viewing of all anatomic compartments, and appropriate ordering of the initial and subsequent radiologic and clinical investigation tools [16,17]. In addition, certain systems changes may help reduce errors. These changes include (1) the creation of an ideal working condition with appropriate time available for interpretation and reporting, (2) the optimal alteration of equipment to prevent accidental error, (3) double readings, and (4) regular open dialogue between clinicians and radiologists [16, 18–22].

The causes of radiologic errors are multifactorial and may be associated with technique, perception, knowledge, judgment, and communication [23]. Errors due to technique may result from poor image quality or examination technique or from the unavailability of previous radiographs or reports. The availability of different multidetector CT scanners offers another opportunity for "error." By triaging a patient to a single-slice scanner when a multidetector scanner is available, one could miss a small lesion because the dynamic study was less robust than a study performed on a multidetector scanner. There are 2 edges to this sword, however. If a 64-slice CT scanner is the best machine to detect pulmonary embolism at a point in time, it is also a machine that will allow the detection of more lung nodules that, in most patients at risk for embolism, will be benign (ie, false-positive findings for lung cancer or lung metastasis from an extrathoracic primary tumor).

The 2 most common categories of radiologists' errors are perception and interpretation. Errors of perception are approximately 4 times more common than errors of interpretation [24]. Other common types of errors are knowledge and communication errors.

Perception errors. It is common to see perception errors in radiology. Reported rates of missing lung cancers that appear as small nodular lesions range from 20% to 50% [25]. Computer-aided diagnosis and second readings, perhaps by a specially trained radiographer, are avenues to explore.

Interpretation errors. Errors in radiologic interpretation arise from many causes, including poor technique, failures of perception, lack of knowledge, and misjudgments [24]. Expert radiologists consistently disagree about image interpretation. Many studies have shown a 3% to 5% interobserver disagreement and error rate [26]. Research has shown that the availability of previous images, not just the reports, improves diagnostic accuracy [27].

The dual reading of mammograms, barium enemas, and CT images is effective in decreasing interpretation errors [20,28]. For example, the dual reading of mammograms increases the number of lesions found by 10% to 15% [28–30]. The dual reading of chest radiographs substantially improves the accuracy as well [31–33]. Furthermore, there is evidence that dual reading is cost effective [34].

Knowledge errors. A lack of knowledge, which is also responsible for errors in radiology, may be related to the training of the radiologists or to the availability of appropriate clinical information at interpretation. Even if a finding is perceived and noted, it may be misinterpreted. This is a judgment error.

Communication errors. Approximately 10% of errors in radiology are related to communication, which includes radiologic examinations performed on the wrong patient, incorrect examinations performed on the correct patient, delays in diagnosis, and a failure to properly communicate the findings to the clinician. Solutions are related to manpower, equipment, standards, teamwork error analysis, and individual core performance [23].

Dual Interpretation With Specially Trained Radiographers. Since the mid 1990s, specially trained radiographers in the United Kingdom's National Health

Service have been the sole interpreters and reporters of accident and emergency radiography, mammography, and ultrasonography in many locations. Research showed that the radiographers had patterns of search strategies comparable with those of radiologists and that the radiographers had a high rate of agreement on the presence or absence of abnormalities. Research also showed that selectively trained radiographers can report and interpret radiographs in a clinical practice with an accuracy equal to that of radiologists [35–37].

The use of physician extenders for double reading of radiologic examinations is worth consideration. In the United Kingdom, accident and emergency radiographs and plain radiographs from general practices have been interpreted by specially trained clinical specialist radiographers. Receiver-operating, characteristic-curve analysis showed no statistically significant difference (at the .05 level) between results from clinical specialist radiographers and from consultant radiologists when reporting on these types of radiographs [38]. Dual reading, with specially trained radiographers working with staff radiologists, may be cost effective for increasing the overall accuracy of the interpretation of selected examinations in the United States.

Step 7: Finalization

All radiologic reports should be finalized before the examination results are needed by the referring physician. Delivery of this service should be actively monitored.

Step 8: Communication

Radiologic Reports. Clinicians have a keen interest in the quality of radiologic reports. The attributes that clinicians value most in an interpretation are timeliness, accuracy, reliability, brevity, clarity, and clinical correlation [39].

Structured reports and standard lexicon. The ACR [40] encourages "precise anatomic and radiologic terminology to describe the findings accurately." In their reports, however, radiologists often do not meet the expectations of clinicians in part because of variations in terminology. In a systematic review of chest radiograph reports from more than 8,000 Medicare patients with cardiac problems, Sobel et al [41] found as many as 14 terms used to describe the single common abnormal finding of "interstitial edema/infiltrate." They found 23 words to describe the presence of a finding. In a survey by Clinger et al [42], 49% of ordering physicians indicated that chest radiographic reports sometimes did not address the clinical question; 40% of these physicians were occasionally confused by imaging reports; and for 14% of the chest radiographs of patients with suspected pneumonia with supportive radiologic findings, the report did not mention the presence of pneumonia.

There is a growing interest and need for a unified, consistent imaging lexicon, which could help radiologists meet several important challenges. An established and accepted lexicon would provide a uniform method and terminology to communicate and access information, which is important for improved communication and for evidence-based medicine. It could also be used to research databases for literature reviews as well as structured reports [43].

Often, radiologic reports do not communicate optimally. The language and the structure of the reports are critical to proper communication, but there is considerable variation in how the most common expressions are used by radiologists [44]. Clinical decisions based on diagnostic imaging depend on the clinician's interpretation of the radiologist's report. The process is complicated by ambiguity or miscommunication.

The typed report presents an important opportunity to communicate successfully with the referring physician. Reports must be clear and succinct and convey important findings that will not be misinterpreted or overlooked. Structured reporting offers an opportunity to consistently and effectively communicate, reduce transcription errors, and increase the efficiency of the reporting process. Structured reports can also be used in outcomes databases for professional oversight.

Radiologic prose reports foster a lack of standardization of content among interpreting radiologists. Itemized reports, in contrast, facilitate thorough documentation of findings and measurements. Itemized reports are more popular among both referring clinicians and radiologists [45].

In an analysis of the 15 most commonly used words and phrases for conveying diagnostic certainty in radiologic reports, there was poor concordance on the diagnostic certainty associated with these phrases, potentially leading to suboptimal care [46]. The standardization of terminology could increase diagnostic certainty and improve communication, ultimately improving the quality of patient care.

Communication to the referring physician. The communication of findings to the referring physician may be compromised by dictation or transcription errors. During the period after interpretation and before the report is reviewed by the radiologist and finalized, the opportunity exists to detect and correct these errors.

Ideally, all reports are finalized and available before the referring physician needs that information for patient care decisions. The timelines of the communication can be measured.

After a report is dictated and finalized, the radiologist's responsibility for patient care includes ensuring that the findings are communicated to the referring physician. This is particularly important for emergent or unexpected, significant findings. In these cases, the referring physician must be contacted directly, either in person or by a phone call.

Patient and Physician Satisfaction. The quality map shows information reaching the referring physician and the patient, where the process started. These steps provide opportunities to measure patient and physician satisfaction, 2 important quality measures.

Step 9: Outcomes

The final step in the quality map, outcomes, is similar to Codman's "end result." If every step on the quality map rates high scores, health outcomes should be improved.

Radiologists should establish evidence-based value for all the imaging and interventions that they perform. The overutilization of imaging services raises concerns related to cost, radiation exposure, morbidity and mortality, and quality-of-life issues related to false-positive results and overdiagnosis bias. Patient care must be about the end result, and radiologists must be willing to publicly display these measures of their practice.

FUTURE DIRECTIONS

Physicians work more effectively and safely when they collaborate in teams. The multispecialty group practice is a model team approach in an environment that fosters learning from peers and shared experiences. This model allows for information to be more readily transferred and shared within and between various disciplines. Large multispecialty group practices lend themselves to tighter control, stronger oversight, and more meaningful performance management [47,48].

Jody Hoffer Gittell, PhD, is the author of *The Southwest Airlines Way: Using the Power of Relationships to Achieve High Performance*. The results of her research in the airline industry and in health care are fascinating. She objectively measured "relational coordination," a measure of how well cross-functional teams work together with trust, teamwork, and mutual respect. Her findings may not surprise anyone who has experienced the power of teamwork. Dr Gittell found that the airline teams and health care teams who worked together respectfully and with a true feeling of camaraderie had dramatically better results. Southwest Airlines is the most profitable airline in large part because the flight attendants, pilots, and mechanics get along. When Dr Gittell looked at 9 hospitals, she found consistently and substantially better results (ie, shorter length of stay, better patient satisfaction, and better outcomes) among teams who had better relational coordination.

High-reliability organizations, such as nuclear power plants, aircraft carriers, firefighting crews, and air traffic controllers have many characteristics in common that help explain their success. One characteristic is that they are preoccupied with failures and near misses rather than successes [49]. An example is the foreign object damage lockdown that all the staff members on aircraft carriers conduct several times a day. All staff members of every rank walk the full length of the aircraft carrier deck looking for foreign objects as small as a bolt that could be sucked into an engine. This is based on a near miss when a bolt was sucked into a jet engine, resulting in an explosion.

CONCLUSION

A prominent theme of Desert Storm, the 1991 Gulf War, was the use of high technology and overwhelming force. One of the important activities was to find and destroy scud missiles. The Air Force dispatched F-15E Strike Eagle fighter jet squadrons to identify and neutralize scud missiles. When a scud missile was launched, an F-15E pilot on patrol would identify the point of launch using advanced, state-of-the-art technology called LANTRIN, a $4.5-million device that was designed to take high-resolution infrared photographs.

Desert Storm commanders were elated with the reports of destroyed scud launchers—approximately 100. Air Force officials were absolutely convinced that this number was accurate because the evidence was documented in high-resolution, infrared photographic detail.

After Desert Storm ended, the Air Force directed a team of investigators to determine the effectiveness of the campaigns. Their startling conclusion was that the actual number of destroyed scud launchers was zero. In retrospect, destroying scud launchers was extraordinarily difficult. Trying to identify a scud launcher was described as "driving down the interstate looking through a soda straw" by Maj Gen Mike DeCuir, who flew numerous scud hunt missions throughout the war [50].

What is the lesson for radiology? Just as Drs Ernest Codman and William J. Mayo emphasized 100 years ago, radiologists need to look at the end results. Radiologists know what their intents are, and they may think they know what the results are, but until they look carefully at the end results, the real-life outcomes, they will not consistently and reliably be able to understand whether they cure or cause harm, such as an infection, contrast-induced nephropathy, or a missed cancer. They will never know whether their tumor ablation or stent placement was successful if they do not follow up with patients for many years.

One of the many lessons of the Baldrige National Quality Program is that there is room for improvement in defining, deploying, and measuring quality consistently across the department. This is a huge issue, actually one of integrity. Because seemingly minor issues may compromise care or certain processes may create a bit more exposure to patient safety issues, each radiologist has an absolute obligation to attend to them now.

Dr Codman had it right: it is time to do it right. But how? It starts with quality maps. For every type of examination, a quality map can be created, even though overlap exists for many examinations. The process of care (the quality map) needs to be defined with the appropriate metrics for each step. Second, determine whether any metrics already exist and prioritize development of those that do not exist. Initially, ideal metrics may not be possible, but that should not interfere with developing surrogates, or samples, as partial measures. One can start with feasible alternatives and work toward optimal metrics. Third, establish quality boards responsible for each quality map and establish a coordinating body that can help provide resources, facilitate sharing of best practices, and assist in integrating changes within the department and the medical center. Medical center staff members will require education, and resources (personnel, time, and equipment) will be necessary. Leadership at the department level must understand and fully commit to the program. Change is always difficult, but it can be facilitated by sharing a compelling vision of the future. Cultural change is even harder and is especially difficult for physicians who perceive a loss of autonomy and new professional oversight as intrusive and inappropriate. The current system has been operational for many years and is desperately in need of change. A new system can be better. It must be better. The time to start is now.

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